CoMapGS: Covisibility Map-based Gaussian Splatting for Sparse Novel View Synthesis

Youngkyoon Jang and **Eduardo Pérez-Pellitero**
Huawei Noah's Ark Lab, London, UK

arXiv Page Video

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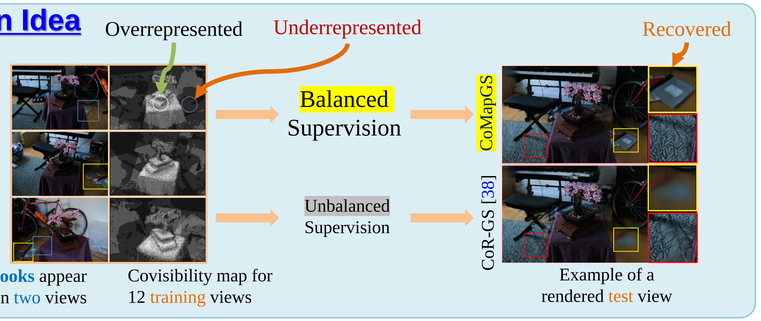
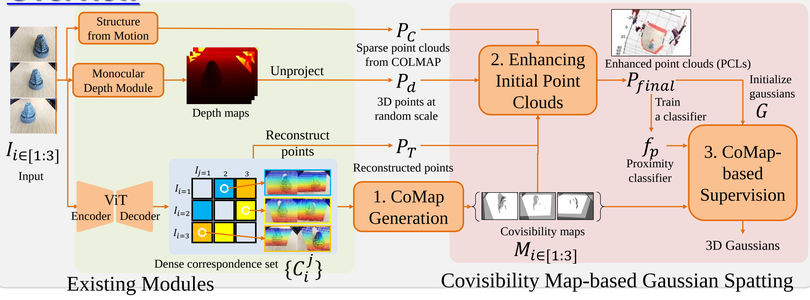
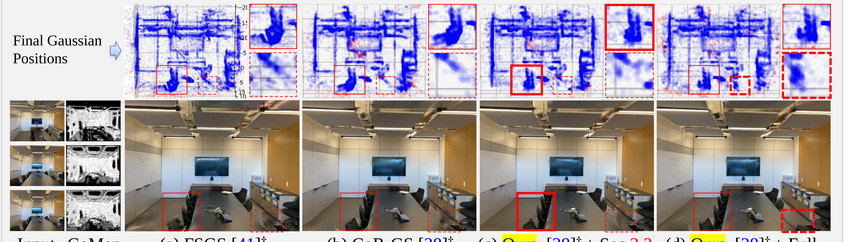
Main Idea



Overview



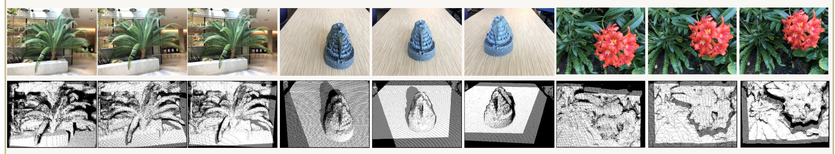
Ablation Examples



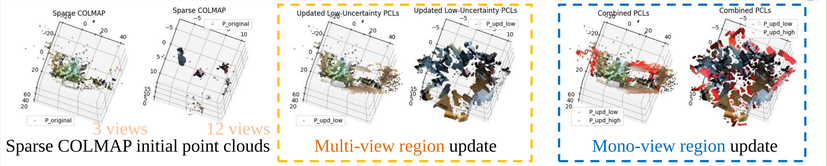
- **(c) Enhancing PCLs** corrects mono-view overfitting and geometric distortion.
- **(d) Geometric Regularization** mitigates over-penalization from multiview constraints.

CoMapGS recovers underrepresented sparse regions by:

1. Constructing Covisibility Maps (CoMap)



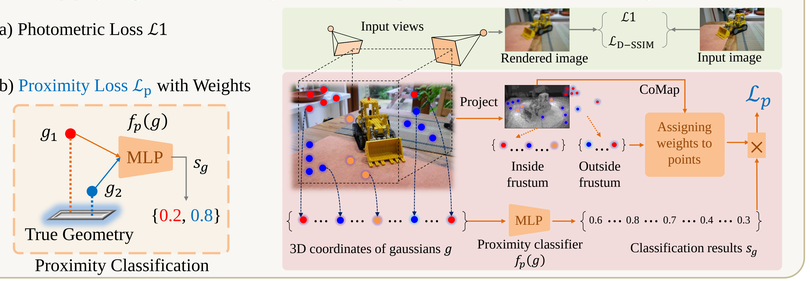
2. Enhancing Initial Point Clouds



3. Applying Uncertainty-Aware Supervision via Proximity Classifier

(a) Photometric Loss $\mathcal{L}1$

(b) Proximity Loss $\mathcal{L}_p$ with Weights



Experimental Results

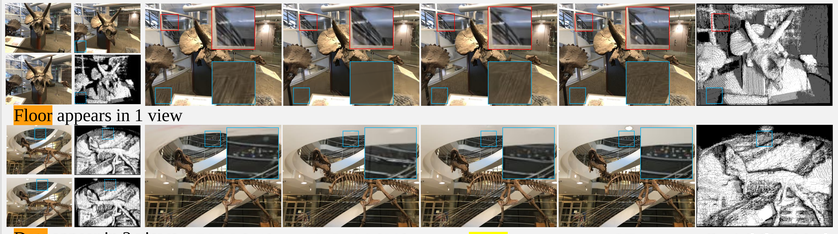
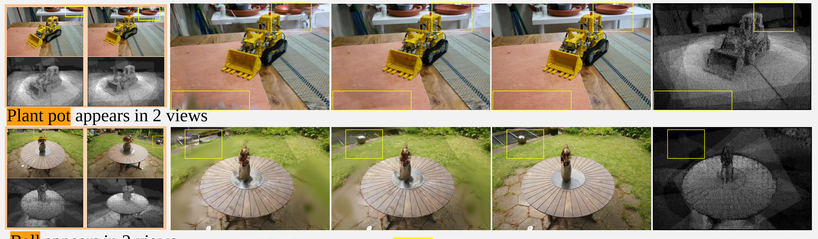


Table 1. Quantitative results on LLFF with 3, 6, and 9 training views.

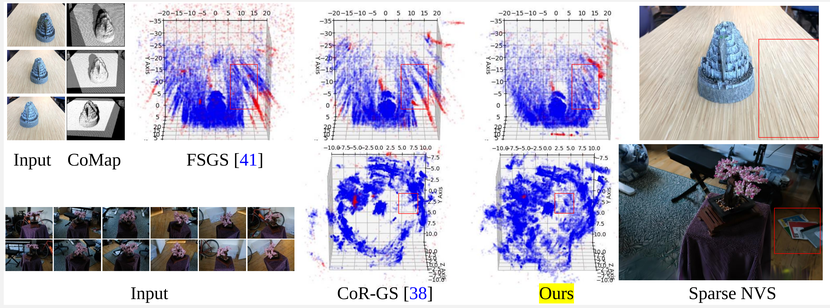
Method	PSNR ↑			SSIM ↑			LPIPS ↓		
	3-view	6-view	9-view	3-view	6-view	9-view	3-view	6-view	9-view
ReconFusion [30]	21.34	24.25	25.21	0.724	0.815	0.848	0.203	0.152	0.134
CoR-GS [38]†	20.473	24.777	26.475	0.717	0.844	0.881	0.199	0.116	0.086
[38]† + CoMapGS (ours)	21.105	25.204	26.731	0.747	0.854	0.886	0.182	0.108	0.082

Table 2. Quantitative results on Mip-NeRF360 with 12 and 24 training views.

Method	PSNR ↑		SSIM ↑		LPIPS ↓	
	12-view	24-view	12-view	24-view	12-view	24-view
CoR-GS [38]†	19.162	23.321	0.574	0.729	0.414	0.271
[38]† + CoMapGS (ours)	19.680	23.462	0.591	0.734	0.394	0.264



Gaussian Splat Positions align with true geometry.



Ours vs MASt3R: Ours robustly prevents ↓ MASt3R errors (e.g., noisy PCLs ↓, missing details ↓, and misalignment ↓).

Conclusions

Sparse NVS struggles in underrepresented (low-covisibility) regions.
We improved this by:
1) Constructing covisibility maps, ***2)*** Enhancing initial point clouds, and
3) Applying CoMap-based weighted supervision.